

## **Method of producing a Steering Wheel Skeleton and Vehicle Steering Wheel**

### **Technical Field**

5       The invention relates to a method of producing a skeleton for a vehicle steering wheel and to a vehicle steering wheel that is produced by such method.

### **Background of the Invention**

10       Known steering wheel skeletons made of sheet metal are usually deformed by deep-drawing and are consequently inexpensive to manufacture. However, deep-drawing essentially only allows the production of U-shaped cross-sectional profiles. In terms of stability, it is better if the profile of the skeleton is bent by more than 180° in the area of the steering wheel rim. Moreover, a further closed hollow profile can easily form a channel inside the steering wheel rim for use in so-called ventilated steering wheels. With such ventilated steering wheels, fresh  
15       air is fed to the inside of the steering wheel rim and exits through holes in the steering wheel rim.

### **Brief Summary of the Invention**

20       The object of the invention is to provide an inexpensive method of producing a skeleton at least for the steering wheel rim by means of which a cross-sectional profile that is bent by more than 180° can be produced at favorable costs.

25       This is achieved in a method which comprises the following steps: a flat metal blank is cut in such a way that it has a ring-shaped section, the ring-shaped section is deformed in such a way that it acquires a hollow profile which in cross-section encloses an angle  $\alpha$  of more than 180°, and the deformation is carried out at least partially in that the ring-shaped section is moved between two rotatable rollers. The rollers roll along the entire periphery of the ring-shaped section, thereby

bending this section. This method allows fast and inexpensive deformation as well as bending by approximately  $270^\circ$ , in relation to the cross-section of the profile.

According to the preferred embodiment, however, the entire bending process is not achieved only by the two rollers but rather, in a first step, the flat ring-shaped section is deformed by drawing in such a way that it acquires an essentially U-shaped profile. Only subsequently is the U-profile further closed by means of the deformation between the two rollers. This combination is especially advantageous since drawing can hardly be beaten in terms of costs and it can already carry out most of the deformation work.

Advantageously, after the drawing operation, the U-shaped profile has two legs of differing lengths, in relation to the cross-section. The rollers engage the longer one of the legs and deform it. Since the legs have differing lengths, a roller can come to lie above the shorter leg and does not need to have a filigree shape in order to protrude from the open side of the "U" between the two legs so that it can engage one leg.

Preferably, the rollers engage the radially outer leg of the U-shaped profile and they bend this peripheral tube section radially towards the inside, namely by approximately another  $90^\circ$ , so that the profile encloses approximately  $270^\circ$  after the deformation step.

When the skeleton is used for a ventilated steering wheel, a number of holes should be stamped into the ring-shaped section before the deformation step, so that the metal blank is cut in a single step.

The preferred embodiment provides for that a one-piece metal skeleton with a section for the steering wheel rim, a section for at least one spoke and a section for the hub are formed from a metal blank, the ring-shaped section being deformed as described above, i.e. the outer leg of the U-shaped profile being bent radially towards the inside. This avoids the need for deformation by the rollers in the area of the spokes, where the U-shaped profile becomes an L-shaped profile. The spokes are also preferably deformed into a U-profile by means of the drawing

method so that the hollow profiles thus formed in the spoke and in the steering wheel rim can be closed by at least one narrow shell part to form an air-carrying channel.

5 The invention also relates to a vehicle steering wheel with a one-piece metal skeleton whose ring-shaped section for the steering wheel rim is deformed by means of the method explained above in such a way that the cross-section of the ring-shaped section has an open hollow profile. A shell part is then attached to the hollow profile in order to form a closed channel.

10 The vehicle steering wheel according to the invention that has holes in the ring-shaped section has at least one fan in the area of the hub that is in flow-connection with the channel in the spoke.

#### Brief Description of the Drawings

15 Figure 1 shows a metal blank that is deformed by means of the method according to the invention into a metal skeleton for a steering wheel according to the invention,

Figure 2 shows a cross-section through the left-hand half of the metal blank deformed by means of deep-drawing,

Figure 3 is an enlarged sectional view in the area of the steering wheel rim during the further deformation by means of two rollers,

20 Figure 4 shows the completely deformed steering wheel skeleton,

Figure 5 is a sectional view through the steering wheel according to the invention in a first embodiment,

Figure 6 is a view through the steering wheel blank of Figure 5 showing a cross-section in the area of the steering wheel rim outside the spokes,

25 Figure 7 is a partially cut-away view of the steering wheel according to the invention in a second embodiment.

### Detailed Description of the Preferred Embodiments

Figure 1 shows a flat, stamped metal blank for the production of a one-piece steering wheel skeleton. The metal blank has a ring-shaped section 10 that later forms the skeleton section for the steering wheel rim, numerous small holes 12 being stamped in this section 10. The ring-shaped section 10 continues into four sections 14 for the spokes which, in turn, continue into a section 16 for the hub.

The metal blank is deformed in a deep-drawing process in such a way that it acquires the shape shown in Figure 2. As a result of the deformation, which is done with a 180° bend (see angle  $\alpha$  in Fig. 2), the ring-shaped section 10 acquires a U-profile with a shorter, radially inner leg 18 and a longer, radially outer leg 20. The section 14 for the spokes is also deformed into a U-profile, with the leg 18 not being present in the area of the spokes 14.

In a next method step, the outer leg 20 which, to put it more precisely, forms a surrounding edge is bent radially inwards by at least another 90° between two rollers 22, 24 (see Figure 3) that are rotating in opposite directions, so that the profile then made encloses an angle  $\alpha$  of at least 270° in the ring-shaped section 10. The inner roller 22 extends slightly above the leg 18 as far as to the inner side of the leg 20, and the roller 24 lies against the outer side of the leg 20. The outer roller 24 presses the upper edge 26 of the leg 20 towards inside, and the roller 22 generates a corresponding counterforce.

Figure 4 shows the completely deformed steering wheel skeleton. As can be seen, the somewhat less open hollow profile in the area of the ring-shaped section 10 continues into the somewhat more open hollow profile in the area of the spokes 14.

In a subsequent step, shell parts 30 in the area of the spokes 14 and of the ring-shaped section that forms the rim are placed onto the hollow profile. The shells are made of plastic and latch in place on the hollow profile, so that interconnected channels 32 are formed in the steering wheel rim and in the spokes. Finally, the skeleton that has been closed with the shell parts 30 is foam-encapsulated. The

reference numeral **34** designates a foamed section. Finally, a leather covering can also be applied. The reference numeral **36** here designates the leather used.

5 In the area of the hub **42** of the steering wheel, motor-driven fans – according to Figure 5 an axial fan **46** – are attached to the steering wheel skeleton via an elastic sleeve **44** so as to be neutral in terms of vibration. Several axial fans **46** can be used or, if the installation space is sufficient, one more powerful axial fan **46** in the area of a spoke can be used. The axial fan **46** sucks in fresh air and blows it through the channels **32** into the surrounding channel **52** in the steering wheel rim (see Figure 6). The air flows to the outside via the openings **12**.

10 Axial fans require a high installation space and moreover, if several of them are used, they are difficult to synchronize. Consequently, precautions have to be taken such as, for example, the elastic suspension **44** so that vibration phenomena do not occur.

15 For this reason, it can be advantageous to use a radial fan, since radial fans require less space in relation to their output. In particular in the case of axial fans, the accommodation close to or in the spokes impairs the design in the area of the spokes.

20 In Figure 7, two radial fan blades, of which only the right-hand air blade **60** is shown, are driven by a shared motor **64**. Each fan blade **60** supplies two channels in two spokes **14** with air which then reaches the channel **52** in the steering wheel rim.

25 In this manner, the use of radial fans leads to cost savings. The arrangement of the fans near the hub ensures that there will be less vibration in the area of the steering wheel rim, which can be even further supported in that each spoke has a radially inner and a radially outer channel section **14'**, **14''** that are kept largely vibration-free with respect to each other via an elastic ring **70**. Muffling of noises can also be realized more advantageously by positioning the fan in the area of the hub **42**.

It is to be noted that the steering wheel according to the invention can  
5 comprise any features of the following method claim in any combination.